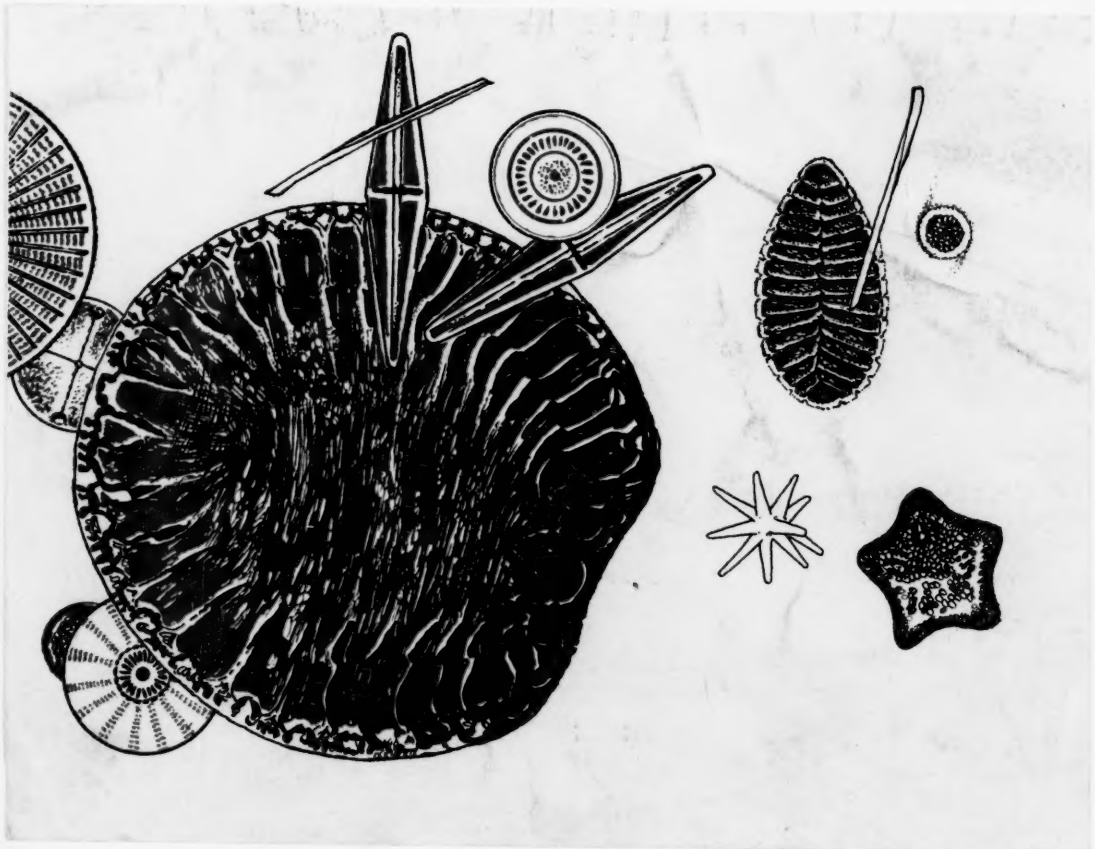
MAIN CURRENTS

IN MODERN THOUGHT



September - October 1961
Volume 18
Number 1

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MAIN CURRENTS

IN MODERN THOUGHT

A cooperative journal to promote the free association of those working toward the integration of all knowledge through the study of the whole of things, Nature, Man, and Society, assuming the universe to be one, dependable, intelligible, harmonious.

SEPTEMBER-OCTOBER 1961

VOL. 18, NO. 1

Editor F. L. KUNZ

Publisher JULIUS STULMAN

Associate Editor E. B. SELLON

Business Manager MARGARET WAGNER

MAIN CURRENTS IN MODERN THOUGHT, 235 East 50th Street, New York, 22, N. Y. The journal of the Foundation for Integrative Education. Published 5 times a year in Sept., Nov., Jan., March and May. Subscription price, $3.50 a year, foreign, $4.00. MAIN CURRENTS IN MODERN THOUGHT is published to call attention to significant contributions to learning currently being made in the multiple fields, relating these advances to each other and to classical and contemporary views of Eastern, European and American thinkers. It is designed to save time for the reader by providing a vantage-ground from which the whole world of knowledge may be surveyed and kept in proportion as it moves toward integration. Its editors assume that the principles of art, the universals of philosophy, the laws of Nature and Man as formulated by science, and the truths of comparative religion, can be orchestrated into a harmonic, meaningful, ethical body of teachings which can and should be made the central core of curricular study in the educative process at all levels. Contributors to MAIN CURRENTS enjoy full liberty of opinion and expression in these pages. Copyright 1961 Main Currents In Modern Thought, Inc., New York. Application for second class re-entry pending at Montpelier, Vt.

ALFRED TAYLOR

Mind and Material

MIND, THE PRINCIPLE WHICH UNIFIES MAN AND NATURE

When we seek to comprehend the world about us there are two different sources of information available to us. On the one hand we receive certain data through the sense organs and on the other we add to these data the thoughts, ideas, concepts which originate in the mind. Our knowledge of nature is an integration of thoughts and things. In ordinary experience we are unaware of these diverse and entirely different categories of knowledge which are combined to give us our sense of reality. It is in this area of sensory data and thinking that misconceptions arise which open the way for such a strange doctrine as that of materialism. There is the tendency to confuse that which comes to us through the mind with that which is purely sensory in origin. However, the differences between the two sources of knowledge are clear and unmistakable.

Relations, concepts, designs, organizations are products of the mind and cannot be received through the senses. Sight, for example, depends upon the impingement of electromagnetic vibrations on the retinal elements of the eyes. Obviously such vibrations contain nothing in the nature of relation, position or design. When we look at two objects, the light reflected from them contains no information about their position in relation to each other. These qualities arise in our minds as interpretations of the data received through the eyes. The above, the below, the further, the nearer, the arrangement of parts and much more are introduced to us through the intellect. Even the idea of number has its origin in the mind. As Albert Einstein has stated, "... the concepts which arise in our thought and in our linguistic expressions are all ... the free creations of thought which cannot inductively be gained from sense experiences. ... Thus, for example, the series of integers is obviously an invention of the human mind, a self-created tool which simplifies the ordering of ... sensory experiences." (*On the Theory of Knowledge*, N. Y., Crown, 1954) It is the mind which introduces the concept of relationship or organization to what is experienced through sight, and the same principle applies to the impressions obtained by way of the other sense organs.

We are in the habit of viewing events and things in our lives from the standpoint of that which is most vivid to us, our sensory experiences. The things we can see, touch, taste, smell and hear appear to be the solid,

This paper is based upon research undertaken with the aid of a grant from the William Hale Harkness Foundation to the Foundation for Integrative Education.

dependable elements in our lives. The result is that our emphasis is on the form side of the affairs of man and nature. In other words, we evaluate objects and happenings in terms of materials.

We note the same preoccupation among scientists of regarding the material as the source of the realities which will explain the universe. It is true that the physicist has gone beyond naive evaluations through sensory data, but nevertheless it is on the basis of what might be called relatively undifferentiated matter and energy that he attempts to account for organic as well as inorganic aspects of nature. In both instances—that of the scientist and that of people generally—a fundamental value is overlooked without which there can be no approach to the reality of the world we live in. Further, when it is recognized and understood it serves as a unifying principle for diverse phenomena of the organic and inorganic realms of the universe.

Thought and Its Materialization

The concept under consideration is simply this, that at a particular level of meaning or informational value a structure consists of organization, a contribution of mind, and material embodiment. Applying this idea to human fabrications we note at once that there is design or pattern originating in the mind and material, or substance, which completes the design so that it becomes functional or communicable. These two aspects of a human construction are entirely different in origin and are incommensurable with each other in the sense that the ink and paper of a letter are incommensurable with its message.

We know, too, from practical experience that the mind and material aspects of meaningful objects are distinct because we can separate them one from another. An intricate machine made on human standards, such as an automobile, begins in the blueprint stage from whence it goes into materialization. Before the car is constructed there are on the one hand the plans, and on the other quantities of metal, glass, fabrics and other materials in relative disorder. The blueprints are of the mind and are separate and distinct from materials which will embody them and so create a functioning vehicle.

It is evident that what has been said about automobile productions applies generally to all man's fabrications and we can appreciate that it is this separateness between ideas and that which materializes them which enables man to progress so rapidly in his machine building skill. A machine is tried out in practice and the experience gained from its use enables the designer to incorporate new ideas into the machine's organization. The individual machine wears out, but the mind aspect of it, the design, goes on through succeeding generations of models. Also, it is apparent that improvements or modifications must be made when the design is out of materialization or in the blueprint stage.

In addition to machines and objects fabricated by man, there are other aspects of human activity which exemplify the same principle. For example, meaningful behavior consists of some combination of that which has its origin in mind with that which provides for actualization. A man goes into the garden and works with his flowers. We observe his actions and they reveal information which is completely at variance with the physical body which makes this behavior possible. There is the idea or the plan of action in the man's mind, and this idea is objectivized by the actions of the physical body. Actually such behavior is more directly associated with mind action than is the design of a machine. In the former instance, there is a pattern of movements which ceases to exist overtly as soon as the man turns to something else, whereas in the instance of the machine there is a projection of the effects of ideas beyond the period in which the mind is directly concerned with their implementation. The mind is actively engaged in constructions only as long as the building process continues. Further, if we think about man and his fabrications it becomes evident that it is only during the period in which mind is embodying an idea or design that there is growth and development of material forms. As long as a carpenter is actively engaged in materializing his plans for a house the structure develops and grows until it emerges in its complete form. Now at this point the mind of the builder is withdrawn and immediately the house begins to decay, to lose the order imposed by a human intellect and to revert to some status of natural order which is maintained by other categories of active forces. This ageing process can be stopped when the house again becomes the subject of building or renovating attention. From this, we note that as far as man's affairs are concerned order is imposed on disordered materials only by the implementation of thoughts or ideas. It is the introduction into materials of appropriate designs which brings about the development and growth of an automobile from metals, glass, fabrics, etc., which were completely void of anything resembling car information. The inertia or stability of these materials allows the machine to be used for a period with nominal attention before the action of another pattern of forces makes the car unusable.

Now where is the essential meaning of the car? Is it not obviously in the organization or in that which is of the mind? Materials are essential to put the ideas into practice but certainly we are not going to appreciate car meaning or car information by studying the chemistry and physics of the materials which implement the car design, any more than we could contact the meaning of a book by investigating its paper and ink. In the productions of intelligent beings there is always the double aspect of the design and the material which embodies the design. The embodiment is perceived through the sense organs but the organization can only be appreciated or created by intellect.

Man-made fabrications illustrate clearly and unequivocally the fact that in these productions the meaning which is of the builder's mind is of one category, and the materialization or objectification is of a different category. Also, the embodied design of one level becomes the material basis for design at another level. For example, a particular alloy of a metal is an example of idea, or formula, and its objectification. The result is a metallic substance which can be used in the materialization of designs which have no relation to the processing of metals. The use at one level of organization of materials which are the result of organization at another level can be extended so that there exists in an apparatus a number of idea levels. However, it is obvious that such complications do not change the relation of design to embodiment which we have been discussing. If we are concerned with a watch, for example, there is the watch design, and all that embodies that design is from this point of reference, material or substance. On the other hand, if in the watch materials there is a certain alloy and we turn our attention to that, then the watch design is no longer relevant. Each combination of idea and material is independent of higher organization levels in which it may be incorporated. These relations occur much more extensively in nature than in man-made structures.

The design of a machine or other structure has a higher order of permanency or survival as compared with its material aspect. The individual machine has its years of usefulness but finally wears out. The design goes on through other machines and is only discarded because competing ideas are more effective. Designs are immune to the ageing or wearing which affects their material embodiments. They represent information available to the mind as it creates new patterns to be used in new productions. We cannot mix the mind and material elements of human productions without arriving at confusing and erroneous conclusions.

Thought values in the human world are the ones which mainly occupy our attention. The material embodiment is a necessity but occupies a lower order of reality for us. This is exemplified in the fact that a message can be communicated by various kinds of physical media, or in the production of a work of art there can be the use of different types of materials. The design is the important item whereas its embodiment is the means through which it functions or becomes manifested. We note this in our appreciation of our fellow beings, animal or human. It is the expression of life revealed in meaningful communications or actions which holds our attention rather than the physical body which makes these possible. Nevertheless though in practice it is the mind values which hold our interest, the delusion persists that the material manifestation is the reality both in beings and things.

It is important for us to appreciate this relation of mind and matter in human affairs because it has implications for the meaning of our lives and the world we live in. Also this concept is not theoretical or speculative but is based on human experience which everyone can appreciate. Consider the automobile and recall how it began in a crude form and how its organization has been carried on and perfected through many years. In the beginning there was an idea for this type of transportation and the idea was formulated in thoughts and diagrams. Then the design was materialized in practical application. Experience was gained from the trial, the design was modified and again put into production. In this way the automobile design has passed through millions of embodiments as it gradually developed into its present form. We know that one of the basic principles of science is the conservation of energy but in the development of these human productions we have the growth and conservation of information. The conservation of energy applies to that aspect of the world which we use to clothe our ideas but the growth and conservation of information, without which there would be no civilization, is of the mind.

Order or Mind in Nature

We have been concerned with the obvious and incontestable proposition that in human affairs the basic reality in all human productions is organization, or design, which is a contribution of mind. Can we then rationally extend this principle and state that organization is also the basic reality in all nature? If this can be done, are we not forced to assume that in nature too organization is a contribution of something in the category of mind? This question was considered briefly in a previous paper ("Organization and Mind in Evolution," MAIN CURRENTS, Jan.-Feb. 1961).

The idea that the basic reality in nature or the universe is organization has been established by the data and principles of science. All the phenomena investigated by scientists whether they be the elementary particles of nuclear physics or the vast aggregation of forms in the heavens are characterized by orderly arrangements of structures and events. Further, our concept of evolution necessitates the conclusion that organization is the key to the diversity of form and movement which characterizes the cosmos. We are now assured that matter and energy are aspects of a common reality resolvable the one into the other and that the universe has evolved by differentiation or organization of relatively homogeneous states of matter and energy. Everywhere and in every time nature is one in essence and in law. The differences we observe are the result of the variability of one factor, and that is the factor of design or organization.

Is there any aspect of nature which is without order? We think of the inanimate materials of the earth's surface as more or less random aggregations, but from the standpoint of the earth as a whole, everything fits into a pattern determined by planetary forces. There are numerous fields of force which in one way or another affect the earth's surface features. We know that these forces must be in harmony with the order of our planetary system since

otherwise the precision of movement and form could not have been maintained as it has for periods of billions of years. More and more the progress of science is revealing that our earth is part of a scheme which is characterized by the delicate equilibrium of massive forces. There is no room for aimless or accidental events. The information now at our disposal is against the idea of disorder at any level of the universe whether in the vastness of the heavens or in the animate or inanimate affairs of this earth. Supposed evidence of lack of order in any aspect of nature arises from superficial or restricted knowledge. It is obvious that detached areas of an ordered system may manifest relative lack of order even though at a higher level of observation they would be seen to be necessary elements in the total pattern.

Disorder is a relative condition. If a hurricane demolishes our dwelling we look upon the resultant debris as an instance of materials in a state of chaos, and yet from the standpoint of the hurricane the materials built into the house have moved towards alignment with a temporary pattern of air pressure. The disorder is in relation to the idea of a house. The same principle is manifested when a living body dies and disintegrates. There is disorganization in relation to a living organism but order in relation to a new set of design values. Whenever there is a change-over of materials from one system to another there is a transitory appearance of disorder. In many situations, too, the time element is an obstacle in assessing the order of materials or actions. The life span of human beings and civilizations is so infinitesimal as compared with the time involved in some of the changes affecting inanimate matter that only a fragmentary understanding is possible. If we evaluate a condition in nature as it appears in the present we are concerned with a cross sectional time view which may not give us knowledge of its real status. A living organism may complete its life cycle in a few hours or a few years, whereas a comparable event in a solar system would be measured in billions of years. On the basis of scientific knowledge, limited as it is, it can be assumed that in relation to the larger universal pattern of things, every aspect of nature exhibits a degree of order.

Our solar system itself is a mighty witness to the organizational values which are the reality in nature. Here mass, movement and time are on a ponderous scale yet are characterized by fineness of design which insures a delicate balance of movements which continue essentially unchanged for billions of years. We can appreciate how perfect the timing of the solar system must be since even a very small deviation would grow in such vast periods of time into disrupting proportions. The precision of the solar system is exemplified also in our own planet by the way the earth's surface temperature has been maintained within narrow limits through great time cycles of the past. We have evidence for this in the fact that conditions suitable for plants and animals, including vertebrates, have been available for hundreds of millions of years. Living organisms will tolerate only comparatively small deviations from the optimum temperature scale. All the details of how this temperature control is effected are not known, but scientists are aware that many factors must be precisely coordinated to bring it about.

Physicists have studied many other aspects of the sun and its planets and have gone beyond to ponder over galactic and intergalactic matter, space and time, and always there is the factor of organization. Also, the designs and patterns of the heavenly bodies are not static but are in constant motion. Matter at the subatomic level is still shrouded in mystery in spite of the brilliant successes of modern scientists, and the same can be said for the vast panorama of giant nuclei of matter which mark the vastness of the heavens. We approach the invisible in matter through inferred entities and concepts which are in accord with laboratory data, while the concepts of astronomy are based on that which is more directly perceived. In both areas of the universe we encounter order and design. It is as if the inanimate universe were created and maintained by a colossal intellect, but one that is not alien to our own.

Organizational values associated with living substance are in sharp contrast with those of inorganic matter. Animate matter is vastly more complicated than inanimate materials. More organization is present in living forms, and this increase in organization begins at the chemical and physical level. Organic chemistry contains the orders associated with inorganic matter plus additional chemical complexities of design. But beyond the chemical level new categories of organization appear, such as cells, tissues, organs, organ systems and the integration of these into a system which functions as a whole. Finally, there is a different level of organization in the animal kingdom which is associated with behavior. In all these different types of order, beginning with inorganic chemistry and physics and proceeding up through the various designs in plants and animals, there are not only striking changes in organization but also differences in the variability of design patterns. At the mineral level there is comparative uniformity and fixity of design. In living forms there is variability and individual specificity even at the biochemical level, and this quality becomes more marked as organization becomes more complex, reaching its apex in the behavior patterns of the higher animals. Organisms which have appeared more recently in evolution tend to show more variability in the way a particular design is expressed.

Our universe may or may not be expanding in space, but it is expanding in complexity and diversity. The process may be analogous to that which we observe in the development of a germ cell into a mature form. For example, a hen's egg is a fairly homogeneous system in

comparison with the differentiation which begins with the development of the fertilized ovum. As we know, in a total time of about 21 days there is a transition which imposes an inconceivably complex organization on the egg materials. Within a time span of 24 hours, a primitive heart has been constructed and has begun the pulsations which will not cease until years later the chicken completes its life cycle. If we think of this developing system in the hen's egg, certain principles become evident which may apply to the total universe of which the egg is a part. We know that development and growth proceed from within and that there unfolds a hierarchical complex of organization. The organization of one level becomes the building stones for organization at a higher level. The process does not follow engineering principles except that everything takes place within the framework of natural law. But natural laws are conditioning, not determining. We are concerned, in this transformation of the egg contents into a chicken, with the embodiment of the design which was contained as coded information in the germ cell.

The tiny chick which emerges from the shell is unique and individual in its total form and in every one of its billions of cells. Yet it has evolved in past ages from matter at the formless level, or from the unruffled space-time which was the precursor of our total universe. In essence it is one with all there is since it has emerged with all else from a common source. Its uniqueness lies in its organization which is the product of ages of evolvement.

The same principle obtains in the mineral kingdom. The elementary particles of nuclear physics form chemical elements by organization of structure and event, and in a similar manner chemical compounds emerge from chemical elements. This sequence continues through the various levels of physical phenomena. Organization is the essential element in natural phenomena and when that organization is completely removed then matter is resolved back into its energy phase. It is interesting to note in this connection that, as Einstein discovered, the amount of energy tied up in mineral matter is related to the speed of light. Light is a form of electromagnetic energy, and matter can be thought of as organized light. Organization serves to harmonize and balance energy, and when it is removed suddenly there is a temporary expression of unbalanced force which erupts in an explosion. If the solar system were suddenly disrupted, enormous quantities of energy would be freed which are normally contained in the equilibrium of solar organization.

Universal Mind

In human affairs, mental activity can be communicated only through meaningful patterns or designs expressed in materials which are perceptible to our sense organs. Further, our thinking activity proceeds through remembered or imagined material designs. This is true whether we are thinking of concrete things of the world we live in or of abstract subjects such as mathematics or metaphysics. Abstract thought such as that applied to a mathematical problem requires some kind of symbols which can be materialized. These principles are exemplified in our thinking, communicating and behavior. It follows that mental activity is always associated with organization or design, and conversely, whenever meaningful patterns appear in association with human thought or activity we take it for granted that intelligence or mind is involved.

Our main thesis assumes that these same considerations apply not only to man's affairs but to the total universe, that there is something in the category of universal mind, and the universe in all its complication of organization and design is a manifestation of this mind. Man himself and his intelligence are aspects of this universal mind and have arisen with everything else in the universe from the undifferentiated matter and energy from which all has evolved. But man is unique in that his being and behavior contain a greater range of design or organization than any other form or system known to science. Hence, on the assumption that organization is of the mind, a human being has, so far as our knowledge goes, a greater representation of the mind quality than any other form in nature. In a human body a hierarchy of interrelated systems includes the intricacy of designs associated with the chemistry and physics of both inorganic and organic materials. In addition, there are the much more complicated structures, events and their relations involved in cells, tissues and organs. Finally, as a climax to all this there are the massive configurations of forms and actions present in the brain and associated nerves. And yet the body with all its unfathomed complication of structures and events is the lesser aspect of the mystery which enfolds every human being. The body serves as the instrument through the action or behavior of which the deeper reality of a person is manifested. It is in the intelligence revealed by his fabrications, communications and actions that man distinguishes himself from the rest of creation.

The concept that the universe is an expression of universal mind is demonstrated in the evolution of man. The diversity of the world has arisen from a common precursor substance. This means that man himself has developed through the ages from this same material whence all else has evolved. Further, he contains in his being all the gradations of material systems common to the rest of nature. Hence we must conclude that mind, as we know it in ourselves, has developed in the course of evolution from that which gave rise to the total universe. Therefore it must be assumed that something analogous to mind was present in all the states of matter through which man has evolved. This conclusion be-

comes more marked as we recall that in man's body there is a series of intelligently integrated events from the single cell up through tissues, organs, organ systems and finally the total human being. At one end of the scale mind reveals itself through beautifully synchronized designs in structure and action, and at the other end through conscious human intelligence. In all this integrated series the meaning is in design or organization. The criteria we use for the presence of mind action in human behavior are present in the meaningful patterns of structures and events of cells, tissues, and organs, and also in the inanimate systems of matter and energy which are present in the body.

The data obtained in the investigation of inanimate matter reveal an organization which is conceivable to our intellect. The world of the physicists is congenial to the human mind. The intellect is at home in such a world just as if some superior intellect, of the same order as our own, had drawn the plans. The late Sir Edmund Whittaker, a distinguished mathematician stated, "The fact that changes in our material universe can be predicted—that they are subject to mathematical law is... most significant... for mathematical law is a concept of the mind, and from the existence of mathematical law we infer that our minds have access to something akin to themselves that is in or behind the universe." ("Eddington's Principle," *Amer. Scientist*, Jan. 1952)

The idea that something in the category of mind is the essential value at all levels of natural phenomena is based directly on scientific data and principles. It is not necessary to introduce speculative thoughts in order to establish this concept. Science certainly proceeds on the basis that the world must be interpreted in terms of scientific experience, and it is solely on this criterion that a universal mind becomes a logical necessity. We know that in human affairs meaningful organizations of materials do not arise from random forces and that the more complex the design the more fantastic it is to assume that it could be the result of chance happenings. If this is so where the comparatively simple structures and machines of man are concerned, then the odds against the inconceivably more complex organizations of nature developing by chance are out of the realm of logic and reason. Further to increase the complete unreality of the hypothesis that the orders and designs of the universe have evolved through the action of mindless, purposeless forces is the fact that the essential organizations of nature are not static but dynamic. A living organism is vibrant with continuous action and change in all its being, and at the subatomic level of matter great concentrations of energy are held in the equilibrium of systems characterized by ceaseless motion.

The fact that science is possible testifies that the source of the universe is akin to our own minds. It is obvious that there could be no sense or science to data accumulated through investigations of a mindless, disordered world. It has been proposed that radio signals might be forthcoming from some of the planets if intelligent beings at our own or higher stages of development exist in these places. We take it for granted that we could recognize organized signals in contrast with those of a random character. For a long time research workers have been concerned with deciphering the signals and scripts of nature. They have had some slight success, and the fruits of their labors constitute science as it is today. There will, no doubt, be much more progress in the future, but we have already advanced to the point where we begin to appreciate something of the power and precision of the universe; and whether it be from the standpoint of the physicist or the biologist we encounter not only evidence of that which would require mind to duplicate it but also incredible complications of design in structure and event which are far beyond anything possible to human intelligence.

Mind Expression and Material Orders

If there is a universal mind which has the unimaginable capacity to evolve the universe, why should there be such an apparent lack of adequacy in so many aspects of nature? Conditions which limit the capacity of the human mind may throw some light on this problem. The limiting factor in the expression of the capacities and qualities of the universal mind must necessarily be the degree or kind of material organization which manifests it. The story of evolution is the story of the building up of designs in structures and actions which progressively allow more of the universal mind potential to become effective. In expressing our own mind capacity and learning, we too are limited by the communicating medium. For example, the philosopher must rely on language to channel his thinking into the minds of others. Only to the degree that the medium of words or other symbols is adequate can he express his concepts. If he were restricted to a primitive form of language which had no words in it appropriate for his needs, his intellectual capacity could be revealed only to a limited degree. A more striking example of the way mind expression is limited by lack of organized systems to express it is evident in our industrial evolution. Down through the ages there has been a gradual increase in the complexity of organization of materials until the point was reached which allowed a relatively rapid expansion of the capacities of the human mind in this direction. If we examine a primitive horse-drawn vehicle we note that it is a relatively simple expression of mind capacity even though it required ages for man to evolve his manufacturing skill up to that stage. But when we turn our attention to a modern automobile we are confronted with a complex integration of organized structures. There is more mind involved in building an automobile because there is

more organization to express it as compared with the cart. We have the same sort of thing in nature. There is more mind revealed in a human being than there is in a cat or a dog, because there is more organization in the former through which the capacities of the universal mind can be manifested. In both man and in nature generally, there is the slow building up of designs and organization which allow the expression of ever more of mind potential, and in this process there is necessarily much experimenting with forms that prove inadequate in practice but provide the information which results in gradual improvement.

Matter, An Expression of Mind

The assumption that the universe is an expression or manifestation of something in the category of mind or intelligence does not necessitate the introduction of a matter-mind duality in nature. There is such a duality if we consider human fabrications by themselves, since we are assuming the human mind to be apart from the rest of the world. But the universe, as we have emphasized before, is one in essence on the basis of the theory of evolution, and human affairs are of this oneness. The reason why there is an apparent duality in human productions, such as a machine, is because the human mind furnishes the design or plan for the machine, but the matter and energy necessary to materialize the design are taken ready-made from the environment. Actually, of course, all productions, a machine, a tree or a star, are of the one nature which includes everything in the universe. Accordingly the mind-matter dualism is an illusion. Suppose we were able to begin with nonperceptible electromagnetic energy and build up from that chemical elements and compounds, then with the materials thus provided we could implement the design for a machine. It is clear that under such circumstances there would be no duality of mind and matter since the matter itself would be a product of mind. Hence the reality, the meaning, of such an apparatus would be mind, both as regards its design and with relation to the materials which embodied that design.

In the course of evolution there has been developed the inconceivably complex organization of a human body. Anything that we can construct or even imagine falls immeasurably short of this accomplishment. Yet this stupendous achievement began far back in time with undifferentiated precursors to matter and energy as we know it at present. From this primitive substratum, materials were developed stage by stage through expanding organizational levels until living organisms became possible, and through the evolvement of certain of these, man came into being. If then the capacity to bring about these ascending levels of organization requires something in the category of mind as it does in human experience, it is clear that matter, whether in the chemical or physical state or as it exists in living organisms, is an expression of mind.

Universal mind, according to these considerations, is universal in the sense that electromagnetic energy is universal. We know that wherever on this planet the requisite conditions are available there will be a flow of electric current. We cannot perceive this energy but we know a little about it from its material effects. Also, the type of observable phenomenon associated with electric energy depends upon the organizational states of the apparatus involved. We can provide conditions which will result in electric current becoming manifested as light, heat or power. Analogous to this is the manifestation of universal mind. The level of organization conditions and limits mind expression. In the evolvement of the universe there is as much manifestation of universal mind capacities at any time interval as there is diversity of form and event in nature.

Order Versus Disorder

The concept of mind as the reality in nature adds to the scope and meaning of scientific data and resolves many of the paradoxes which have puzzled scientists. There is, for example, the second law of thermodynamics. This law arose from the observation that when two systems of matter and energy of different temperature levels are in contact with each other, the system with the lower temperature becomes warmer and the system at the higher temperature becomes cooler. This principle also concerns entropy or disorder, and in this form states that a system of matter and energy left to itself will assume a state of maximum entropy or randomness. According to Max Planck, "The Second Law of Thermodynamics, with all its extensions, has become the Principle of Increase of Entropy," and again, "Whatever takes place within the system the entropy can only increase." (*A Survey of Physical Theory*, N. Y., Dover Publications, 1960) We see evidence of this law in the disintegration of human fabrications and especially in the decay of the dead forms of plants and animals. From this principle it has been postulated that the total universe must go from order to disorder, or as it is said, the universe is running down. On the face of it, such a law should make it impossible for a formless system of matter and energy ever to develop differentiation. Hence, the idea of a universe arising from a homogeneous field of matter should be impossible. The proponents of the concept that nature has evolved through the play of random forces take refuge in the idea that the second law is a law of probabilities: that, for example, if a container of hydrogen and a container of nitrogen are joined together they will *tend* to become a homogeneous mixture, but it is possible that if sufficient time were available the two gases could again become separated. The possibility of this happening would be progressively decreased as the number of mole-

cules of gas increased. To propose that the complication of order involved even in one living organism could arise in this fashion takes us out of science into the miraculous raised to the nth power.

It will be recalled that James Clerk Maxwell, the physicist who first proposed on theoretical grounds that light is a form of electromagnetic energy, pointed out that if two vessels containing a mixture of gases, such as nitrogen and hydrogen, were joined together with an opening between them just large enough to allow one molecule at a time of the contained gases to pass from one vessel to the other, it would be possible for a tiny demon to manipulate a door back and forth over the opening so that only molecules of hydrogen would be allowed to go into one container and molecules of the other gas would go into the other vessel. In this way, in the course of time and without adding energy to the system the second law would be nullified, since the two gases would be separated thus decreasing entropy. The point of Maxwell's demon is that it introduces intelligence or mind into the situation. We observe the reversal of the action of the second law whenever living organisms are involved. In the instance of the chick embryo development mentioned earlier there is a dramatic example of the introduction of increasing order into a system. As far as the individual chick is concerned, reversal of the law is temporary but the essential result is to increase chick information in the universe. The chick represents millions of years of accumulation of experience with the propagation of chick design which has been gained in the process of developing countless millions of bodies. To apply the second law to the matter and energy which materializes chick design is perfectly valid, but this principle does not apply to the reality of the chick which is its organization. The body dies and disintegrates, but the chick design continues in the tiny points of material known as the germ cells. We can appreciate the lack of application of the second law to design when we think of it in connection with a book or a painting. We know that in these instances laws pertaining to the material aspect of these objects do not touch, in any way, their meaning or value, and the same is true for the entire range of higher organizational states from an amoeba to a man.

The physicist is concerned with states of matter which have been stabilized through vast periods of time and so have the appearance of systems of matter and energy characterized by automaticity and mechanization. These states of matter enter into the materialization of later and more variable designs in which the time element is of a different order from that of the organizations of the embodying material. However, since all the phenomena of nature, whether a crystal or a living organism, can be reduced in their material aspect to the systems of matter and energy of mineral states of matter, it has been assumed that the stable inorganic or mineral matter contains the meaning or the key to the problem of the more highly evolved systems. Accordingly, it is the custom at present in scientific work to seek to understand the complex designs of living organisms on the basis of knowledge gained by studies in chemistry and physics. As we have pointed out before, this is tantamount to attempting to acquire the meaning of a machine by studying the materials which embody the machine organization. It is obvious that we cannot get machine information from the metals and other materials used in the machine's manifestation, and likewise the meaning of a higher organization in nature cannot be obtained from the lower orders of matter which materialize it. This is true in matter at the chemical and physical level. A study of chemical elements does not give us the meaning or value of a protein compound.

Cause and Effect

Even the law of cause and effect can only be applied to the materialization of a design, but not to the design itself. Certainly this principle in its engineering implications cannot be demonstrated to be effective in the world of ideas or mind. A study of the chemical elements does not provide us with knowledge of the compounds arising from their combination. In the instance of the more complicated organizational levels of plant and animals, when the end product of a sequence is known we are unable to work out the chain of causes and effects. For example, it is totally beyond our present knowledge to link a mature plant or animal with what we know of the germ cell from which it arose. We do know that a living form begins with one cell and we can describe the various steps of development, but the process by which the single cell becomes two is almost completely unknown. The growth of living substance does not proceed according to engineering principles, as mentioned previously; development is from within so that there is never either completion or noncompletion. At any stage of development and growth the living organism forms an integrated pattern, and as it proceeds to a new organizational level everything which has gone before is incorporated into the new design.

If we conceive of the universe as the product of something in the category of mind then it follows that while everything must proceed in accordance with natural laws, it would be impossible to predict the orders which are to emerge in the future. The diversity of nature which we can comprehend only dimly with our limited knowledge bears witness to the inconceivable capacity of universal mind. This great complexity of the universe as it exists now is the result of manipulations of a common precursor substance. Beginning with relatively formless systems of matter and energy, mind has brought forth all that is. As we think of this it becomes obvious that we

are not in a position to know whether the forms and happenings of nature are determined or not determined. After they are established, there is then the possibility of establishing a causal or deterministic relationship with previous conditions with relation to the material embodiment, but this does not touch the problem of accounting for the particular design, such as a tree or a bird, which utilizes materials for its expression.

Living forms represent organized systems which have been evolved during long periods of time. Today's plants and animals are the end products of a chain of evolutionary stages. Something of this is preserved in the embryological development of animals as the embryo passes through condensed recapitulations of its evolutionary history. It follows then that a presently existing living organism is an expression of a design or organization which has been modified and perfected through many generations of forms. When a germ cell develops and grows into the mature status of a particular plant or animal, it is undergoing a process which has been repeated an almost countless number of times in the past. During the course of evolution that which is now a routine performance was slowly developed, and numerous design innovations were eliminated by natural selection. But gradually the organism was modified and changed until it attained the current status.

As we observe living forms, we see evidenced the same principles of design and its materialization which we have considered in connection with human productions. The germ cell corresponds to the blueprint stage of a machine. As the germ cell goes through its various stages of development and growth, we have something analogous to the implementation of the blueprint. The embryonic plant or animal grows into maturity and after a period of time grows old and dies. Likewise the machine is manufactured from the design summarized in the blueprints and it too after a period of time grows old, as the process of disintegration renders it unfit for further use. But the design in both instances is preserved so that new models can be materialized. Also, in nature as well as in man's fabrications, changes or modification can occur only when the design is in the blueprint or seed stage.

Is Evolution Directional?

The question arises, is the evolvement of animals, plants, planets, galaxies directional in any sense that we can detect with our very limited knowledge? As far as the animal kingdom is concerned the answer appears to be definitely in the affirmative. The available data plainly indicate that animal forms through the ages of their evolvement become more intelligent at the behavioral level. This is demonstrated by the fact that the fossil remains of existing types of animals reveal a progressive increase in brain size, and our knowledge of present forms enables us to conclude that brain size, other things being equal, is a factor in the growth of intelligence. The primitive ancestors of modern reptiles, mammals, and some types of insects were characterized by relatively smaller brain size. From these observations it appears that widely separated animal forms are evolving towards increased mental capacity. On the other hand, if we consider bodily structure of both plants and animals, we note that a refinement as well as an increasing complexity of organization and design have occurred in the course of evolution. The contrast between the bodies of the dinosaur group of reptiles with modern reptilian types is most striking in this regard, as are the primitive Eocene mammals compared with present day forms.

The trend in evolution is towards higher levels of organization or, according to the thesis we are presenting, towards higher levels of expression of universal mind potential. It is as if nature were striving to obtain ever greater capacity for manipulating matter and energy into forms which permit ever higher stages of mind or intelligence to become active. The process seems to be symbolized in the way a seed or a germ cell fulfills its nature whenever conditions permit it to do so. A fertilized ovum rapidly increases its dominance over matter and energy as it expands into progressively higher stages of organization until, if it should be a human ovum, it has provided the form, the mature human being, which manifests such a degree of mind as to be capable of drastically affecting other orders of nature.

Some Consequences of the Mind Concept

Let us assume that the basic reality in this universe as we know it is something akin to mind. What then are some of the consequences for man's ideas about himself and the world he lives in?

To begin with, this concept unifies beings and things. All phenomena, from the chemical elements to man himself, are products of that force which organizes energy into perceptible matter, and from this evolves a universe in all its aspects. When we consider the numerous fabrications and activities of man we know that they are all manifestations of human intelligence. The human mind is the source of the ever widening flood of human thought and constructions. It is the unifying principle which makes human activities more intelligible. Likewise the larger mind of the universe which encompasses man and all his works unites and harmonizes the incalculable diversities of nature. Differentiated systems of matter and energy emerge from undifferentiated or formless systems by appropriate organization. Chemical elements are formed which in turn give rise to compounds and thence to the rest of the inorganic and organic realms of nature. Through it all there runs the thread of accumulative experience or information. The lower stages of organization are necessary for the production of the higher stages and are incorporated in them. In every direction the past

is alive in the present, and the present dissolves into the future. There is constant motion, constant change but all is ordered and integrated by the wisdom of nature.

Design or organization characterizes the universe, but it is organization of things in motion. This is true of atoms and heavenly bodies and it applies also to living organisms. Matter flows through the bodies of living forms. The only aspect of a human body, for example, which endures from year to year is the organization. During man's lifetime tons of material substance pass through the design of his being. The material content of every cell in the body is continually being changed. Also, there is a particular rhythm which characterizes the events of nature which unites diverse aspects of the universe. Forms have their beginning, maturation, decay and disintegration. This sequence is exemplified in such widely separated events as the life cycle of a man and a star, and the works of man, as we all know, follow the same trend. Throughout the universe from the very small to the very large, there is organization manifested by transitory embodiment. Materialization brings a thought, an idea, a plant, an animal into action in situations for which they are adapted. But in order to apply the experience gained in action it is necessary that the old forms pass away and new forms arise. Hence we see the rationale, the necessity, for the never ending rhythm of forms developing, maturing and disintegrating. Death becomes a natural consequence of the concept that mind is the reality in nature.

As we recognize these data, which are part of our experience, in their true import, our outlook in life is changed. Much human suffering is occasioned by the fact that time makes such a difference in the appearance of things. The forms that mean most to us change and finally disappear. There is a life span for our bodies, and our clothes, cars, houses are all finally erased away by the passing years.

The evidence before us indicates the world to be a reflection of the restless quest of nature to express more and more of the mind potential of the universe through the organizations of materials into forms of increasing complication and harmony. Nothing of value is lost. Even the cast off vestures of designs are broken up and woven into new design embodiment. The course of evolution bears witness to the conservation of real values. The fossil record demonstrates how experience gained in the forms of the past has led to the more intelligent forms of the present. Man himself is the fruit of information gained through the transitory lives of countless animal types of the past. This principle of the conservation of experience, or information, in nature must be effective generally since the progress of science has more and more established the uniformity of nature. There is in animal evolvement the development of types, of species, but there is also individuality. Each single animal is unique in its cells and tissues and in the behavior of its total being. This, too, must in some way be conserved and continued beyond the death of its particular physical expression. Just how this can be so is beyond the domain of scientists, even though it is a logical consequence of that which is in accord with scientific data.

We have pointed out before that the cycle of germ cell-embodiment-germ cell, or in human production, blueprint-machine-blueprint, should apply to the universe as a whole, and it is interesting to note that this idea is advanced in the *Bible*, "And, Thou, Lord, in the beginning hast laid the foundation of the earth; and the heavens are the works of thine hands: They shall perish; but thou remainest; and they all shall wax old as doth a garment; And as a vesture shalt thou fold them up, and they shall be changed: but thou art the same, and thy years shall not fail." (Hebrews 1: 10-12)

If we think of universal mind in the sense that "Lord" is used in the passage from the *New Testament*, it becomes plain that the principle advanced in the scripture is the same as we have been concerned with in our discussion. The universe itself is taken as the temporary embodiment or vesture of that which endures and continues in other universes of the future. On the basis of our knowledge of more limited aspects of nature, we can assume that the succeeding universes will have built into them the experience gained in previous trials.

The structures and events of our world are made up of design and embodiment, or mind and material. But as a result of our vivid sensory impressions we tend to concentrate our attention on the material aspect of things. It is very difficult for us to appreciate that the reality within ourselves and in all nature is something that has neither length, nor breadth, nor depth, and is outside of time, yet is manifested through vestures which have these dimensions.

F. L. KUNZ

The Film of Living Beauty

A BRIEF PASSAGE

FROM A BOOK IN PREPARATION

PHYSICS REPORTS ONLY UPON THOSE FEATURES of the unseen universe in which matter is embedded and in which radiant energy is at work; and this is inevitable, for matter, energy and motion are its main concern. But in establishing with certainty the universality of gravitational and electromagnetic force fields, and in documenting the reality of metric fields, it has also offered to biology—and, thereby, in turn, to the sciences of man—release from thraldom to crass physicalism. Since both life and man are materially manifested, and since now matter itself turns out to be a particulate foreground in the continuous and universal background, then *all* that we experience outwardly may at last—with the active aid of science—be submitted to basic reinterpretation, in confidence that what we know about life and man can also be restated in terms of that wholeness which the background, by its very nature as a continuum, supplies to the foreground.

When the details and the larger meanings of this achievement within physics are applied to the rest of the known universe, it becomes clear also that the integrity of knowledge and experience, long lost in education (where it is styled the divorcement of the sciences and the humanities) can at last be restored. For the new knowledge leads up to old insights. It shows that matter itself cannot be said to exist, in the old sense of something occupying space; that what seem to the senses to be substantial objects must be taken to be organized local results of non-material harmonic field-and-particle forces. With physics and chemistry demonstrating that the very root of all sensed nature, matter itself, is musical and symmetrical, why should not the arts be regarded as *affective* statements of the very same reality which science is now making clear in *intellective* forms? The creative artist is working in and with the same Continuum* as the physicist. That he initially *feels* it, and the scientist *thinks* it, is but a difference in ways of going at understanding and expression of one and the same universe. When these two modes are divorced in education, disaster is invited. Science becomes heartless and art becomes witless.

In the restoration of integrity, novel and fascinating labors lie ahead. They may be arduous. For it will not be easy to dismiss age-long assumptions that sensing is knowing. It has never been even good folklore, which modestly and truly has claimed merely that seeing is believing.

*This term will be used with a capital "C" for brevity's sake to refer to the background, all force and metric fields of nature which at present are known or yet to be known.

To the senses our planet (for example) appears substantial, but it is now more correctly thought of as a globular cloud spinning and swinging along in the gravitational and electromagnetic fields. It may be called a cloud because it is known that the constituent atoms are mostly space. The space is not empty of meaning and power, but consists of force and metric fields, which may be called the working space of nature. Since the fields are continuous, the planets—and indeed the solar system, the Milky Way, and other galaxies—are assembled particles of electronic foam, each little particle of it centered up in a nucleus. In the case of our earth, the bulk of the foam aggregates as (1) the core, (2) the mantle, and (3) the thin outer plastic cover—a heaving, broken crust.

When we turn from the three-dimensional globe of matter and consider life, the need to re-assess thought in terms of the new knowledge becomes even more acute. Over the cover or crust is a very thin coating of protoplasmic substance, made up of the waters, the multitude of individual creatures, and the fertile earth, which is fruitful because the creatures' remains enrich it. As a soap bubble is made up of inter-linked molecules of fat in watery solution, the particles being discrete but held together by the forces between them, so the biofilm is made up of plants and animals held *to* the planet by gravitational, but held *together* by bio-psychological forces. These latter forces are very different from those studied in physics, but they are no less compulsive, real and important.

The biofilm is never more than some five miles through, and that only at the places where mountains are highest or the oceans are deepest. At those higher levels it is embodied in organisms flying and floating in the air, in the community of creatures above the tree line; on rocks, in snows, and in glaciers. At the lower levels, it is seen at work in the creatures of the deeper seas and lower ooze. At this extreme the variety and the density of the populations are relatively small.

Where the biofilm is most dense, with numerous, diversified creatures held closely together by their own nature and need, it is only a few hundred yards through. This is near the surface of the seas, and in and on the fertile soil of the land. Here millions of species and variants form a system held together not only by material exchanges, by energy-trading in known force fields, but by psychobiological forces, which (I repeat) are also real and necessary. This biofilm may be thought of as being, in practice, a two-dimensional system. For the most significant part of it is this *very* thin sheet just below and just above the surface of the seas and of the lands. Here live not only the vast company of plants and of simpler animals, but the whales, porpoises, manatees, seals, land marsupials and mammals, and birds: the warm-bloods; and here live men, those strange, self-aware and seemingly self-responsible particles, which literally swim into being as part of the protoplasmic film, an ovum which is set afloat as an embryo, and emerges as infant, child, youth and adult, to disappear from sight as the life-force fades, the functions of mind falter, and the form falls away.

Whether thin or thick, the seen biofilm is in effect only a two-dimensional section of reality, in space. It is a scene in which fluid, insubstantial forms, persistent in time, present the orders of life. Since the forms are material, the discoveries of the physicists have shown that all of this apparition, without exception, is—like the earth—froth, materially speaking. But it is shot through and through and thus sustained by the Continuum in some manner at present unknown.

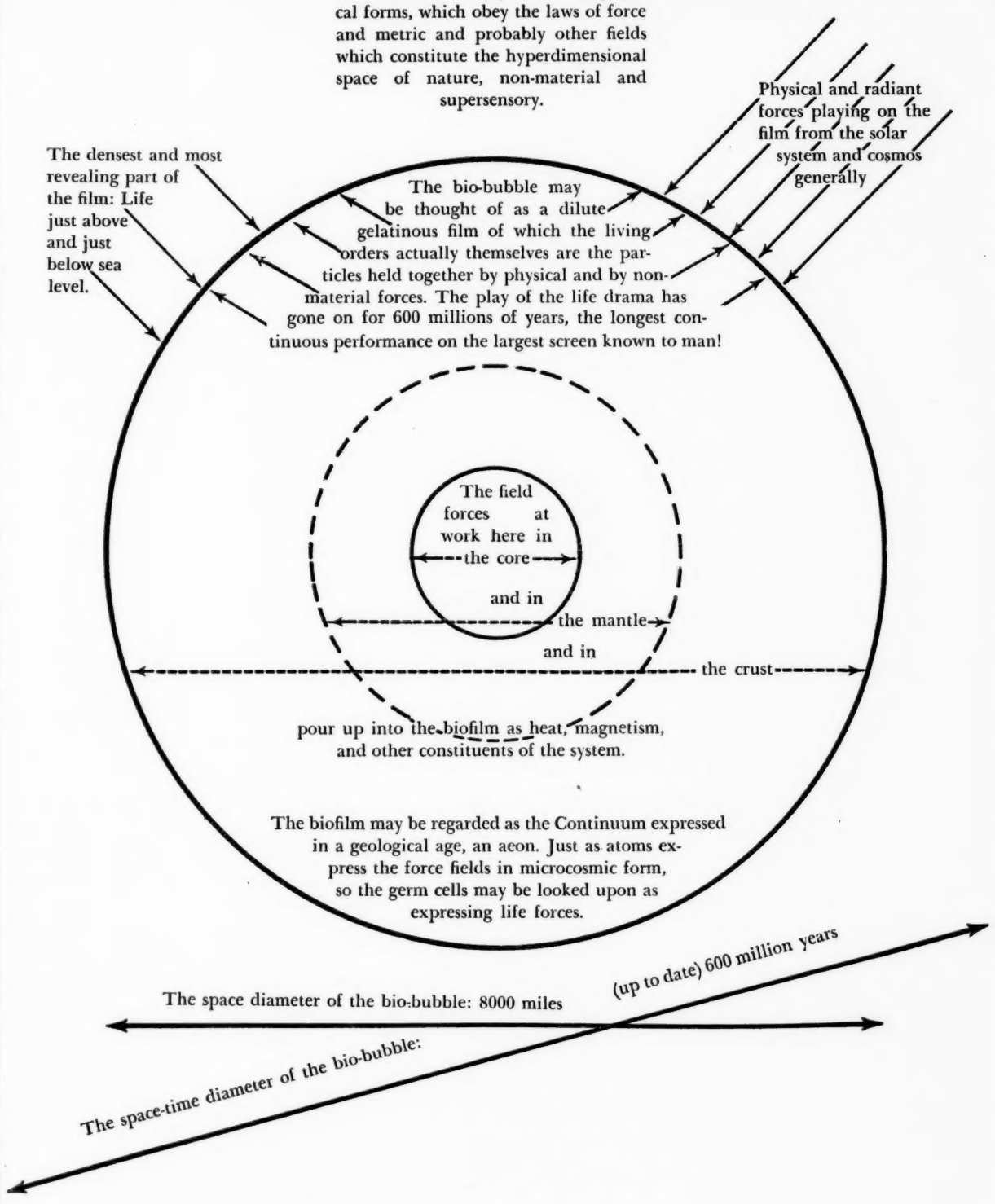
The living biofilm has been likened to a motion picture. The latter is a two-dimensional illusion which has its immediate causal origins elsewhere, namely, in the three-dimensional projector, and its true origins in the actual scene that was photographed. This analogy is quite misleading. In the biofilm of the earth the creatures and events are the direct display of forces at work above it, below it, and all through every particle of it. The principles at work in a plant or an animal derive not only from the three- but, at the very least, a four-dimensional domain.

A better analogy (mentioned above) is a soap bubble, a very thin sheet of discrete fatty particles. It is no more a contact continuity than the life film on the surface of the continents and oceans is continuous in space. The soap particles are held together by non-material forces (surface tension, chemical bonds, etc.) intimately associated with and involved in the very nature of the lipoid particles. So, at the densest level, the mammals, birds, trees, plankton, fishes, insects and the like constitute a durable film. The cohesive forces at work are psychobiological, seen as symbiosis and ecology. There is a known reason why, to the creatures, these *are* real forces. They can operate on the creatures by the very nature of the substance of the creature-cells, each one being made of a slippery material, protoplasm, which in its own right is bio-psychological. The biofilm is thus made up of material suited to respond to psychic life-force.

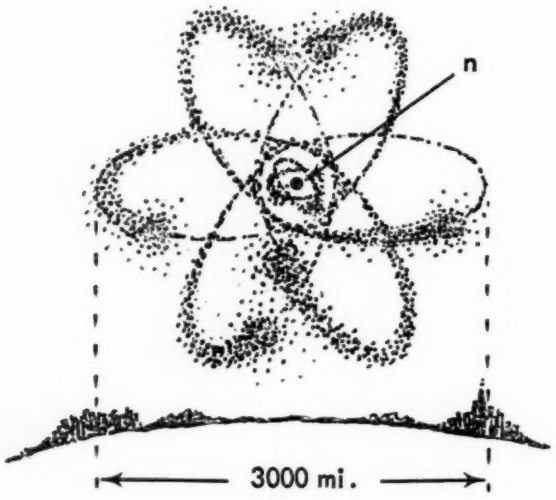
Hence the biofilm, like the soap bubble, is made up of particles (creatures) which cohere because they are made of precisely the right material to lead to coinherence in a peculiar kind of force field, as yet unknown for the reason that research is not seriously directed toward it. Like the soap bubble, the biofilm is not important in terms of amount of matter or of volume in space. It is practically two-dimensional. But it has an unexplained persistence in time. Unlike the soap bubble, the biofilm is tough, having lasted now probably about six hundred millions of years.

Modern physics prompts us—and biological science forces us—to look for the true origins of the living forms not in the visible seed-substance, which supplies the species with material continuity through reproduction, but in the Continuum. The study begins with the fact

The Biofilm as a Bubble in Space-Time


A thin slice of reality clothed in physical forms, which obey the laws of force and metric and probably other fields which constitute the hyperdimensional space of nature, non-material and supersensory.
Physical and radiant forces playing on the film from the solar system and cosmos generally
The densest and most revealing part of the film: Life just above and just below sea level.
The bio-bubble may be thought of as a dilute gelatinous film of which the living orders actually themselves are the particles held together by physical and by non-material forces. The play of the life drama has gone on for 600 millions of years, the longest continuous performance on the largest screen known to man!
The field forces at work here in
the core
and in
the mantle
and in
the crust
pour up into the biofilm as heat, magnetism, and other constituents of the system.
The biofilm may be regarded as the Continuum expressed in a geological age, an aeon. Just as atoms express the force fields in microcosmic form, so the germ cells may be looked upon as expressing life forces.
The space diameter of the bio-bubble: 8000 miles
(up to date) 600 million years
The space-time diameter of the bio-bubble:

that matter itself is insubstantial. An atom of oxygen, enlarged to stretch from San Francisco to New York would have a nucleus (hovering over some spot in Iowa) only about 500 yards in diameter.[1] Insofar as matter is



mass, this would be most of it, the electrons being eight elliptical standing waves, or probability regions. They may be pictured as cloud-like forms with negligible mass; negative in electrical charge, each one localizing a single unit of magnetism. But in fact, the nucleus itself is discontinuous, and it now appears that it also is a wave-system. In short, an atom is a minute volume of space in which characteristic and exquisitely organized and balanced wave motions are going on. They are not waves made of, in, or on a substance, in the sense of sound waves in air or surface waves on the sea, and if we persist in thinking of them in that fashion it becomes necessary to say that an atom is a wave-system made out of, and occurring in and manifesting the existence of, force fields.

[1] The diameter of the oxygen atom is about 10,000 times that of the nucleus.

[2] A thousand miles an hour at sea level, at the equator.

An atom is, then, a minute local manifested force field system in a universal and continuous force field potential. The atom is appearance; and enough of them systematized into molecules can be seen. The potential is a deeper reality, and everything, and every creature, and every process of nature, inheres therein.

Various forms of energy are concentrated on two sides of the biofilm, a three-dimensional arrangement which allows the whole range of the electromagnetic spectrum to play upon plants and animals, from the sun above. This is so filtered through the atmosphere of the earth that what would be lethal is strained out, and what is important to life is let in. Under this incessant barrage the earth slowly turns[2] and is alternately toasted and cooled down, by day and by night.

From below, the earth, the waters, the air supply every creature with forces (and materials) which derive, really, from the same sources as the sun. The earth heaves with tidal waves (which travel right across continents), it develops patterns in its local fields, and indeed the whole solar system operates out of hyperspace as a process in time. The thinness of the film, the slight open spaces between individual creatures, facilitate the incessant exchanges that go on.

In days when mechanism and materialism were the mode, the biofilm was thought of as a meaningless slime that arose by chance, and man as a miasma, a vapor. All this is obsolete. The living orders can be more appropriately thought of today as being physically a two-dimensional slice of reality, with an enormously long history, or dimension in time; and if we are to do justice to their truly unique features, as systems of forms (phyla) suited to incessant psychic activity, we have also to inquire —as a preliminary to a new look at ourselves—into the kinds of continua for which a gnat, a giraffe, or a cedar may be intermediaries, just as a dynamo is a functional form plying its trade between the electromagnetic field and the sensed physical world. Protoplasm is more specialized—and more exquisitely complicated, for its complex purposes—than iron and copper, which we find specialized at hand for electrical systems.

All of this wants re-thinking in the terms prescribed by the new knowledge.

SOURCE READINGS: Integrative Materials and Methods

The Need to Restore Integrity to the Science of Life

INFLUENCED BY THE TREND TOWARD SPECIALIZATION and by the power of physical science and engineering techniques, modern biology is rapidly becoming more and more dependent upon the exact sciences. These have come to occupy an increasingly important place in all areas of biological research, but the levels of application are different. The fast-moving fields where the greatest advances have been made are those in which the biological problem has been reduced to chemical or physical terms; these command the greatest resources and draw to them the most competent students, whereas other areas of biology, more traditional in their approach, have less appeal and fewer resources. The influence of biochemical and biophysical techniques, which began by attacking specific problems susceptible to such treatment, has spread to the point where they now reach deep into the core of biology—to reproduction and inheritance. Some scientists, such as Isaac Asimov, hold that biology is a system that proceeds from biochemistry to the associated subjects of neurophysiology and genetics, all else being, as used to be said of the non-physical sciences, "stamp collecting." So penetrating has been this attack upon biological science that Asimov begins Vol. 2 of *The Intelligent Man's Guide to Modern Science* with this statement: "Modern science has all but wiped out the borderline between life and non-life."

Doubtless many biologists and biochemists agree with this statement. Barry Commoner, however, is one who does not. Writing "In Defense of Biology," in the June 2, 1961 issue of *Science*, he offers excellent reasoning and some explicit evidence why the integrity of biology must be maintained if physics and chemistry are to be properly applied to the problems of life. These problems still remain untouched, in spite of all the recent advances, in such unanswered questions as: What is the cause of speciation? How do cells differentiate? What processes dictate their division, growth, and cessation of growth? How does inheritance control these developmental processes?

As Commoner points out, the view that biology is only an unresolved form of chemistry and physics is not new. Certainly a great deal of knowledge about chemical substances has been gained from the consideration of specific problems in biology. Yet the question remains, how much real benefit has accrued to biology from these findings? An example might be cited in the history of research on starch. Early classical morphological research produced monumental works on starch grains, which have unique structural organization closely correlated with the plant's specific character. In more recent years an equally impressive body of knowledge about the chemical substances (amylose and amylopectin) extractable from the starch grain has been accumulated, and the enzymes that synthesize these substances have been isolated. Yet, Commoner says, "an analysis of the information available from studies of extracts shows that we do not understand how the enzymes could possibly account for the presence together in the starch grain of both amylose and amylopectin in proportions which are under genetic control. Clearly, our attention must now return to the developing starch grain, and we must learn how the enzymes are disposed within it, and how the cellular environment can give rise to a precise correlation between the two paths of biosynthesis that cannot be accounted for in terms of test-tube chemistry. The stage is set for a fascinating marriage between the classical studies of the starch grain and modern starch biochemistry and biophysics. But to my knowledge no proposals have been made, consummation is a distant prospect, and fruitful results are even more remote." The reason for this is to be found, in Commoner's view, in the separation, even alienation, of classical and modern aspects of biology.

This process of alienation has had one very unfortunate result which in the long run may have devastating effects upon biology itself. As soon as an interesting and important biological problem becomes susceptible to chemical or physical attack, the question becomes lost to biology. But then the chemical or physical studies run their course and in the end run upon the blank wall that still surrounds the intimate events which occur within the *living* cell. But the alienation has now gone too far, and a return of the problem to wider biological consideration is not undertaken.

As was mentioned in the beginning, one result of the application of biochemical techniques to biology has been the view summed up by Asimov. The evidence offered in support is that, in the end, biological processes are resolvable into, and dependent upon, purely chemical substances. To the most meaningful problem in biology: At what moment in the history of matter did life appear? The answer given is: The key step was the formation, through chance combinations, of a nucleic acid molecule, capable of inducing replication. That moment marked the beginning of life. This, it is held, is true because all the substances of living matter depend in the last analysis on DNA (deoxyribonucleic acid, a molecule which contains all the information required to specify the inheritable characteristics of the organism), and it is the vehicle for the continuity of life. If it is accepted that nucleic acid

is an encoded form of life, capable of self-duplication, and that it can bring about the translation of its own code into the remaining aspects of life, then it follows that, given a reasonably healthy environment, nucleic acid can indeed create life and perpetuate it. Since it is also indisputable that nucleic acid is a chemical substance, it follows (if all this is true) that life is essentially nothing more than an expression of the chemistry of nucleic acid; the physical basis of life is established.

This argument would seem to establish the priority of the physical sciences in biology. But Commoner offers evidence from three important sources for another proposition, namely, that "the analysis of living systems, based on modern physical and chemical theory, leads to the conclusion that life is unique and that it cannot be reduced to the property of a single substance or of a system less complex than a living cell." The evidence he cites supports the view that the fundamental theories of physics and chemistry give no justification for the "obliteration of the boundary between life and non-life."

The first piece of evidence comes from the work of W. M. Elsasser upon the hypothesis mentioned above, that DNA in the germ cell contains in an encoded form all the information required to specify in detail the inheritable features of the adult organism. Elsasser points out that recent advances in computer theory set fairly precise requirements on this hypothesis: (1) The information content of the amount of DNA present in the germ cell of a complex organism, such as a horse, should greatly exceed that present in the cell of a more simple organism, such as an amoeba; (2) Cells should contain a device for translating the code library contained in the DNA into the biological characters which it determines, and computer evidence indicates this device ought to be considerably more massive than the library. The available facts, however, suggest that living things do not meet these requirements. In brief, evidence does not support the idea of a one-to-one correspondence between genetic information and that represented by the structure of DNA, and no one has yet discovered a structure, considerably larger than the chromosomes (the code library), which shows evidence of serving as a translator of the information in DNA into the numerous anatomical features that are also inherited.

Thus a strict analysis of the problem of inheritance in accordance with modern information theory leads to the remarkable conclusion that the organism's specificity must be determined, at least in part, by agencies not present in the initial germ cell, and certainly not in the DNA alone. (Elsasser points out that this view is identical with a principle already well established in biology—epigenesis, which holds that the fertilized egg begins with a limited amount of specificity, which develops into more detail in progressive, superimposed stages.) These results call into question the basic assumption that DNA or any other simple component of the germ cell can serve by itself as the arbiter of biological specificity.

Another notable and well-known defense of life as something unique and distinct from non-life has come from the physicist, Niels Bohr. Commoner cites Bohr's application of his theory of complementarity to biology. According to Bohr, this theory, which states that the electron is characterized by both particle and wave properties which are mutually contradictory, is a *general* law which may regulate the relationship between two coeval aspects of biological systems: the existence of life in the whole intact cell, and the separate physicochemical events that occur within it. The more precisely we try to determine the internal events of a cell the more likely we are to destroy its life. Bohr concludes that the existence of life must be considered an elementary *fact* in biology, just as the existence of a quantum of action has to be taken as a basic fact in atomic physics. Bohr is not a vitalist. His principle serves however as a warning that we cannot study the property of life without retaining it in our experiments. Thus, Commoner shows, "The penetrating insight of modern physical theory reveals certain inconsistencies in the notion that life can be reduced to the chemistry of some special substance."

Another analysis of the problem has been made by Sir Cyril Hinshelwood, this time from the viewpoint of the kinetics of complex chemical systems. He states that "the view that nucleoproteins are the basis of genes which could ever be self-replicating in isolation and merely in virtue of their structure is probably a dangerous oversimplification. . . . The picture presented is essentially static. The phenomena of growth, adaptation and reproduction need a dynamic one." And he suggests an alternative source for the self-regulation of living cells: "The building blocks of the cells, wonderful as they may be as structures, are useless by themselves. Cell function depends upon the rhythm and harmony of their reciprocal actions." It is Hinshelwood's view that nothing less complex than an entire cell is capable of *self*-duplication.

Thus the three views quoted reveal a remarkable agreement with the biologist's long-held opinion that life is inherently complex and unique. Commoner believes that this convergence of conclusions results from the fact that the authors have applied modern physical and chemical theory to the problems of life with the same standards of depth and rigor that are required in the treatment of purely physical and chemical problems. Thus the physical sciences may be a powerful ally of biology if the alliance is a true one, and if biology maintains its integrity.

Finally, Commoner brings the problem within the province of all of us who are compelled to suffer the devitalizing effects of engineering that takes little note of the long-range and total effects of its specific projects. In pointing to the social implications of the future of biology, he writes: "It appears to me that in the recent applications of science to social problems, there has been an increasing tendency to ignore the facts of life. Too often, we are pre-

pared to expose miles of countryside to substances known chiefly for their power to kill. By the time we have dispersed insecticides, herbicides, fungicides, nematocides, pesticides and other assorted agents, the adaptive latitude of the ecological environment, which is so vital to the success of plant, beast and man, may have been fatally restricted. I sometimes think that the difficulties we now face in controlling water, air and soil pollution, and the undue dissemination of radio-active materials, are the result of a common impression that 'the boundary between life and non-life has all but disappeared.' In fact, if we do not mend our ways, the statement may, after all, turn out to be true.

"I believe that the time has come to restore the science of life. We need to do this for the sake of the science, and for the sake of that which is the goal of all science—the welfare of man."

—*E. B. Sellon*

The Way We See

THE 26TH ANNUAL SESSION of the Indian Academy of Science opened on Dec. 27, 1960 at the University of Madras, in Southern India. The Presidential address was entitled "The Physiology of Vision," and was delivered by Dr. C. V. Raman, Nobel Prize winner in Physics. Dr. Raman is the discoverer of the so-called "Raman Effect" by which details of the human retina's response to light of specific colors may be investigated. In his address, as reported in *The Hindu,* Dec. 27, 1960, Dr. Raman clarified many hitherto-unrecognized details of the visual process.

One such detail concerns the eye's sensitivity to color-differences. Another concerns the biochemical role of three visual pigments whose absorption-spectra, by overlapping, cover the entire spectrum of "visible light."

According to Einstein's theory of light, the quantum of energy associated with a photon of light varies directly with the *frequency* (or color) of the light. Einstein's formula for the quantum-energy of light ($E=hv$) states that the energy, E, is the product of a constant (h; Planck's constant) and the frequency (v). The value of v for red light is 3.7×10^{14} cps; and for violet light it is 7.4×10^{14} cps. The ratio of these two values (2:1) indicates that a photon of violet light will have twice the quantum-energy of a photon of red light. However, so sensitive is the human eye that, near the violet end of the spectrum, the eye can distinguish between two colors whose energies differ by only 1/1000th of the energy-quantum at that point. And at no place in the entire spectrum does the eye require a change of more than 1/100th of the energy-quantum (at that point) to distinguish a distinct difference of color.

Under favorable circumstances, therefore, the human eye can distinguish a scale of about 250 colors, each of which is a distinct and different visual experience. Thus the *biochemical* situation in the retina must be one of fine sensitivity and considerable complexity.

The generalized mechanism is as follows: Within the retina are a number of protein substances (retinenes) which undergo chemical changes when they are struck by light of specific color-frequencies. When a photon of light strikes a "rod" in the retina, its associated retinene changes energy-state, and the rod "discharges" along the optical nerve path. The resulting nerve-pulse reaches the optical center in the brain, where the transmitted energy registers as a color-sensation. (The rod must now "rest," while its associated visual-pigment is re-constituted.)

There are three such visual-pigments, or retinenes, which, with some overlapping of their ranges, provide visual sensitivity to the entire color spectrum from deepest red to visual violet at the border of ultra-violet. *Xanthophyll,* a yellowish pigment, has strong absorptions in the blue and violet portions of the spectrum. Its absorption curve drops steeply as the color shifts to the greens. Two other pigments cover the rest of the color spectrum, with considerable overlapping of their absorption curves. They are the *ferrous* and the *ferric* forms of the iron-porphyrin complex known as *heme*—the same heme which, in combination with different proteins, plays a role of extraordinary importance and versatility in both plants and animals.

Heme, for instance, associated with the protein "globin" forms *hemoglobin,* the substance which gives to blood its red color and which plays a vital role in the oxygen- and CO_2-transport mechanisms in animal blood. The identical 4-porphyrin group, centered around a single atom of magnesium (instead of iron) is the key structure in *chlorophyl,* the catalyst which enables plants to absorb energy directly from sunlight. In certain marine organisms we find the blood-pigment *hemocyanin,* in which copper substitutes for iron, in the heme complex.

The ferrous and ferric forms of heme, then, are the visual pigments which make possible the eye's sensitivity to the greens and yellows, through orange to red. *Ferro*heme has a peak absorption in the green, and *ferri*heme in the red region of the visual spectrum. Where their absorptions overlap, we find the yellow and orange portions of the spectrum. They are about equally sensitive to yellow light, but the ferro compound's absorption drops quickly beyond orange. Ferriheme's absorption then extends to the end of "visual red," at the infra-red end.

The work under Dr. Raman's leadership which has so greatly increased our understanding of the biochemical mechanisms involved in human vision has added dividends in other aspects of science as well, and even in the philosophy of science. The evolution of functional forms in nature can no longer be held to be the result of purely fortuitous and accidental mutations, in a program of natural selection which is both blind and mindless. The development of multiple functions for a single organ has always been an argument against such selection. But the

point is enormously strengthened by the discovery of mechanisms like the multiple functioning of a bio-chemical compound, such as that of the *heme* group.

For herein we discover that a group of four porphyrin molecules, assembled symmetrically around a *single metal atom*, and then associated with proteins of various sizes and complexities, becomes a star performer in not just one function—or within a single group or even a whole phylum—but variously throughout *both* the vegetable and animal kingdoms. And it may appear in multiple functions within the same organism, as in both the blood-chemistry and the retinal-chemistry of the human organism. There is yet to be added one more startling and significant fact concerning the development of visual systems in living organisms which casts some doubt on the possibility of a "mindless" evolutionary process.

Speaking very basically, the development of a visual system for a living organism involves two quite distinct and separate functions. Vision involves the manipulation of the signal of light rays, (subsumed under optics) and the translation or transduction of *radiant energy* into an isomorphic nervous response; this later state being more the concern of biochemistry.

There are three distinctly different *types* of eyes in use by living organisms, each of which has advantages over the other two systems for the creature using it. We are most familiar, of course, with the vertebrate eye lens system, since this is the system human beings utilize. There is also the multiple lens system of the insect world; the many-faceted eye of the common fly is a good example. Then there is the less-familiar eye-on-a-stalk, to be seen on lobsters and other exo-skeletal marine organisms. The accomplishment, by living organisms, of the two functions involved in seeing may be summarized as follows:

Optical systems in use: *three*. Biochemical systems in use: *one*.

Organisms using three types of lens-systems utilize a single biochemical mechanism for processing the input from the optical systems. In all three the nerve message follows the breakdown of a light-sensitive, heme-like retinene, which discharges along a nerve conduit to an optical center in the cortex where the message assumes meaning for the organism.

In recognition of Dr. C. A. Raman's contributions to human knowledge, the Indian Academy of Science has this year endowed, at Madras University, a new Chair in Physics, to be known as the Raman Professorship of Physical Science.

—*Alan Mannion*

Biological Abstracts for May 5, 1961 has a precis of an article by E. E. Leppik entitled "Evolutionary Differentiation of the Flowerhead of the Compositae," made by the author.

The differentiation of flowerheads considered by Leppik is held to be a recapitulation of the main sequence of floral evolution, performed in a new form at an accelerated speed. All the main phases of this sequence are well demonstrated in this plant group. Besides, there are many observable trends and connecting links which permit an interlocking of these phases into a lunar evolutionary sequence, as follows: amorphic (shapeless), haplomorphic (simple-shaped), actinomorphic (ray-shaped), pleomorphic (several shaped), stereomorphic (solid shaped), zyglomorphic (yoke-formed). The recapitulation of the whole evolutionary sequence in the gradual differentiation of the flowerheads of the Compositae has great interest in itself and particular importance for the study of evolutionary correlations between insects and flowers. Here is well demonstrated a continuous selective process, carried on by certain groups of insects, which are guided by their inherited sensory mechanism. According to the present theory, this sensory mechanism must have evolved in insects parallel with historical differentiation of flower types, and therefore tends to keep the evolution of flowerheads of the Compositae in a certain predetermined sequence.

Thus the phenomenon of recapitulation which integrates evolution in animal species is also a factor in plant differentiation.

A BRIEF NOTE IN *School Science and Mathematics* for October 1960 indicates that Russians have been pursuing investigations into the influence of the earth's magnetic field upon living organisms. According to this report, Russian scientists have discovered that the growth process in plants is definitely affected by the magnetic field of the earth. The existence of this phenomenon, which is considered to be experimentally proven, leads to the conviction that polarity is a fundamental property of all living material.

Magnetotropism is defined as consisting of the oriented growth in the direction of the earth's south magnetic pole or an artificial south magnetic pole. It is similar in effect to phototropism, the attraction that makes plants turn towards light. Research has shown that magnetic influence on plant root growth is greatest when seedlings are in the embryo stages, and when these embryos are oriented along an imaginary line drawn from pole to pole, rather than crosswise of the magnetic field. When a seedling has its roots directed toward a natural or artificial south pole, both the roots and stem swell and grow faster than usual. When turned with roots toward a north pole, the seedlings grow more slowly. There is also evidence to support the view that magnetotropism may influence cancer and radiation effects.

Readers will be interested in laying this research against that of H. S. Burr of Yale, who, in collaboration with F. S. C. Northrop, has since 1944 conducted examinations of the influence of electromagnetic forces upon living forms, mainly trees, and whose experiments have led him to the conclusion that an electrostatic field sustains and controls the processes of growth.

News and Notes

THE ANNOUNCEMENT OF THE SUSPENSION from the compulsory list (for three years) of the Columbia University course for sophomores, Contemporary Civilization (CCB), is a serious portent.

At the end of the First World War (1919) Columbia instituted a course for freshmen dealing with the roots of European culture (CCA), which continues on the compulsory list. Following as it did upon the widespread feeling that the disintegration of the European-centered, classically anchored philosophy was at hand, CCA represented Columbia's contribution to General Education, as that movement took shape in the nineteen twenties. CCA had excellent benefits, and produced nationwide effects on other campuses.

Contemporary Civilization (CCB) came into being (1929), as an attempt to deal integrally with the modern world, in which philosophically ungoverned science plainly was proving to be educationally destructive and its technological outworkings, as they emerged haphazardly, debasing. It preceded the Second World War by a decade. By 1940 we were once more engulfed.

Now another twenty years have passed. The fear, fever and ferocity of the third World War rages in individual psyches and consumes us. Physically it surfaces in Laos, the Congo, Cuba, North Africa. Meantime, General Education is displaying the paralysis which was inevitable for a long-known reason: It is impossible to mix in one course, as if they are equals in philosophical authority and richness, the exact and the approximate sciences. The inductive, descriptive, statistical, simple measurement, nonnormative sciences overwhelm, by their mere quantity, the exact, deductive, metaphysically-rooted sciences, which by their nature confer philosophical and longer-lasting gains. Not only do the former overwhelm the latter by sheer bulk, but they seem to be easier to understand, since they employ hypotheses drawn from sense experience, from statistical measurements, and the like. Moreover, these measurement sciences, inferior though they be, are the only means immediately available for attacking topics of vast importance to man: Life and functional forms, and man and his works. The Education Editor of the New York *Times* (July 16th, 1961) makes the distinction with devastating simplicity (and, I may say, misleading oversimplification) when he speaks of "sociologists, anthropologists, scientists and economists."

Is it not high time that the Federal Government took an interest in this long drawn-out agony of the universities and directed its attention to solving a problem for which there are no funds, no independent agency, no sustained continuity of inquiry, no proper establishment? The universities have shown, as reviewed above, that they know we are in danger, educationally. Each World War has caused a renewal of activity on campuses: forty years have now passed, and still the endeavors of sensitive and concerned men and women all over the country are left to their spare time, over-crowded professional hours. Obviously it is hopeless to expect the old-line fund-granting Foundations to do much about all this: it has been in front of them all this time. (We would like to be proved wrong about this!) In the national interest it is time that the Federal Government gave leadership.

Lately the State Department created a new office, Assistant Secretary of State for Educational and Cultural Affairs, announced February 27th, 1961, at the White House. The first incumbent is Dr. Philip H. Coombs. The Office of Education sustains an Assistant Commissioner for International Education, the experienced and gifted Dr. Oliver J. Caldwell. The present Commissioner of Education himself, Dr. Sterling M. McMurrin is, by good fortune, through educational background and personal orientation, a philosopher. The Chairman of the Foreign Relations Committee of the Senate is a man rightly known all over the world, among educated folk: Senator Fulbright. Surely these men and others could get together and concentrate some serious expert attention upon this problem? The fact that it has proved refractory on the campuses only makes it the more important. There are a few men and women of the highest possible academic rank who have given their lives to an understanding of the real origin of the defeats, and the true nature of the solution. In the last two numbers of MAIN CURRENTS the issue was briefly defined once more.

We speak therefore plainly to the President himself. The present administration would go down in history as the saviour of this nation if it were to concentrate some of its vast resources upon an objective just as clearly before us as is the issue of peace. Failure to understand the nature of the problem and to act from that understanding lies at the root of the breakdown of constitutional government in this country. Other Presidents have called high-level educational conferences. None of these studies was directed at the central problem of the integration of modern knowledge so that it can support contemporary man in the face of his ethical crisis. So far, despite the ability of the resource persons called upon, this problem remains unanalyzed and hence unresolved. For something like a hundredth of the cost of putting one man one time in space for a few minutes we could put the whole educa-

tional system on the right track. Are not our children and their children entitled to this? Should we not restore confidence in "the Laws of Nature and of Nature's God" throughout the educational system, *by means entirely proper in a secular school system,* thus strengthening free men everywhere?

—F. L. Kunz

AT THE BOTTOM OF THE SEA, like layers of greyish brown mud, and at the greatest depths, there lies dead plankton that has accumulated through the ages. It contains calcareous shells of rhipopods, crustellaria (or foraminifers), siliceous casings of radiolarians, and the siliceous membranes of unicellular plants or bacillariales—the diatoms. In previous geological formations, there used to be lentil-shaped foraminifers belonging to the nummulite family which attained the size of a pocket-watch. The mountain ranges of North Africa, which provided almost all the material for the construction of the Egyptian pyramids, consist almost entirely of nummulites.

Foraminifers and diatoms are alike microscopic, unicellular, and characterized by their ability to create little protective calcareous shells, usually smaller than one millimeter. These minute organisms—plant and animal alike—were among the first inhabitants of our planet; they likewise form today an important component of the teeming life of the sea. A foraminifer is a particle of living plasma, a cell without shape, which spends its whole life floating through the vast spaces of the sea, driven by the currents. It is endowed with a miraculous instinct which enables it to form minute shells through whose tiny apertures it pushes out fine threads of protoplasm. In one cubic meter of water from the warm seas more than a thousand millions of varied organisms have actually been counted, a community of diverse members known collectively as plankton. Formed of both vegetable and animal organisms, this plankton is a prerequisite for all marine life. It was indeed the primeval food of every living creature on earth. The whole sequence of the development of the inhabitants of the sea, in which each is in turn devoured by another, from the smallest anemones to the giant whales, could not have come about in such amazing variety if it had not been for these minute primeval organisms. And as all life on earth has evolved from the sea, this apparently insignificant plankton has greatly contributed to the evolution of all living creatures inhabiting the earth, not excluding man himself.

The tiny creatures like the foraminifers, which although unicellular are nonetheless animal, themselves live on other unicellular organisms, these being seaweeds and bacteria—the diatoms, such as appear on our cover. These organisms seem at first glance to be little different from the creatures described above, for they, the bacillariales, are also plasma cells encased in two siliceous shells clasped together like the lid and lower part of a box. The difference between these organisms, which are plants, and the crustellaria, which are animals, lies in the fundamental ability of the bacillariales to take nourishment from inorganic substances—a process beyond the power of any animal. The myriads of diatoms float in their microscopic casings in those layers of the sea which are penetrated by the sun; in the presence of sunlight they are able, by the process of photosynthesis, to produce, from inorganic matter, tiny drops of fat and deposit them on their bodies. These nourishing bodies of the diatoms then become the basis of all marine life, for the crustellaria, rhizopods and radiolarians depend upon them, together with the so-called Peridinae, for food. The diatoms are thus true plants, since like those which are more complex they are able, within their bodies, to change inorganic matter into organic substance by the process of assimilation of carbon-dioxide with the assistance of sunlight, heat and water, thus producing starch, sugar, fats and protein. Animals are not able to perform this chemical process, and so must depend on plants for nourishment. This is, of course, equally true of carnivorous as of herbivorous and omnivorous animals, for the former devour the creatures which have themselves already been nourished upon plant life. Plants, in other words, can live without animals, but animals cannot live without plants, which are in a real sense the origin of life upon earth, the basic material of the biofilm.

Notable features of the diatoms are their exquisite geometry and the brilliancy of their coloring. Thus at the very beginning, living nature appeared as geometry and as (so to speak) embodied light. All this is the primal statement of a theme to be worked out in evolution. Now, at the other end, hundreds of millions of years later, the theme of stereometry and of congelation of light continues in creatures whose forms and functions have stretched at last from the amethyst—which merely *is*—to the hummingbird, with all its throbbing, be-jewelled intensity and freedom. In the face of this constancy over the ages, the notion that the biofilm is merely a slime creeping upward *only* by trial and error is irrational and untenable.

ANNOUNCEMENT HAS BEEN MADE of a new journal published in India, called *Darshana.* It is described as an international quarterly of philosophy, psychology, parapsychology, religion, mysticism and sociology, and its editorial board contains representatives from Italy, Israel, Germany and Australia, as well as the United States. The magazine is intended to be an interpreter to the West of Indian philosophy and culture, especially as embodied in the six systems of the Darshana in which its metaphysical and philosophical heritage are focussed; it is also intended to be an interpreter of Western scientific thought to India.

Inquiries should be addressed to *Darshana,* Moradabad, India. J. P. Atreya is Managing Editor.

Reviews

THE SCIENTIFIC WORLD has had to wait about sixty years for a review and analysis of parapsychology fitted to stand beside the two-volume classic by F. W. H. Myers. C. J. Ducasse has now supplied a critical examination so searching as to provide re-education for the open-minded skeptic—and invaluable modern documentation for those familiar with the facts—in *The Belief in Life After Death* (Thomas, Springfield, Ill., 1961, 307 pp., index, $8.75).

In his *Human Personality and its Survival of Bodily Death,* Myers collected the most significant cases of every class of paranormal phenomena, and applied to them his incomparable classical knowledge and the scientific criteria of the 19th century, which latter, being mechanistic, was inadequate to the materials. This brought to a close sixty years of psychical research.

Since then (1905), physics has dismissed matter, putting in its place standing waves in open fields, and transformed things into processes that range from granite to sea gulls to man. Meantime also the patient and indomitable laboratory and field work of a few, inaugurated by the statistical studies of J. B. Rhine and his colleagues, supplied convincing repeatable empirical data. That program has provided all the advantages which the method affords. It was a firm start. Intellectually free and courageous men in many universities were thereby challenged and inquired for themselves. The factual data thus accumulated is diversified, and supplies all the *prima facie* evidence needed to make a good beginning on a theoretical system which will link parapsychology to the rest of the sciences.

This beginning is precisely what Prof. Ducasse now patiently and competently provides. He calls the work "a philosophical scrutiny," but since physics itself has been for some decades a species of metaphysics, the distinction is one without a difference, so long as the philosopher stays within the area where data and reason meet. Myers was compelled to speculate. Ducasse has the advantages which Einstein, Minkowski and the rest of that bold brood have conferred upon us. Science itself has laid open the non-material background of the sensed foreground, in force and metric fields. In the time of Myers, the dead still had no more place to go than did the so-called shades in the days of the Greeks. In these days of Ducasse they can depart, leaving behind all the matter that made them physical processes, and still—insofar as physics is concerned—by no means thereby cease to be. For in physics today "to be" is not necessarily to be sensed. No one sees a force or a field, yet it *is*.

Prof. Ducasse takes advantage of this revolution. He points out immediately in his preface that whether a life after death is possible or not for the individual is a question seldom formulated unambiguously, or approached with a genuinely open mind, or discussed objectively on the basis of the relevant considerations. The discussion usually originates in a bias for (religious) or against (scientific), and sooner or later becomes argumentative. The position of spiritualists has been somewhat intermediate between these two extremes, since they hold that belief in survival should be a matter of experiential knowledge rather than faith; yet the testimonial evidence they present has frequently been tinged with religious attitudes. Prof. Ducasse has set for himself the task of considering that issue without prior commitment.

The author, who is Professor Emeritus of Philosophy at Brown University, has already published extensively in this field. Thus he commands that maturity of judgment which only long conversance can afford. His criteria are those of a senior professor in a university. He is thus armed and has been exercised as few have been for this endeavor.

The book begins with a definition of the concept of immortality, and the reasons for belief or disbelief, both religious and non-religious, most of which, while convincing to many, really *prove* nothing. His examination shows that the whole question turns upon the use of certain key concepts, such as material, mental, body, mind, consciousness, life, and so on, which are usually used both freely and frequently and no less inexactly and ambiguously, and which therefore have beclouded the whole issue. Accordingly, Ducasse devotes a large middle section of his book to a consideration of the key concepts and to the attempt to answer specifically the relevant questions, for example: What objects and events are material or physical? Which things are living? Which things are mental? What is a mind? It is obvious that before the matter of survival of bodily death can be seriously considered, or even discussed rationally, there must be consensus as to the meaning of body and mind, and some agreement as to the nature of their relationship. As Ducasse says (page 62):

"The hidden premise of the contention that the cessation at death of all evidences of consciousness entails that consciousness itself then necessarily ceases is, evidently, that the relation of brain activity to consciousness is always that of cause to effect, never that of effect to cause. But this hidden premise is not known to be true, and is not the only imaginable one consistent with the empirical facts listed in Chapt. III [which facts, it has been contended, show that the existence of consciousness is wholly dependent on that of a living organism]. Quite as consistent with them is the supposition, which was brought forth by William James, that the brain's function is that of intermediary between psychological states or activities, and the body's sense organs, muscles and glands. That is, that the brain's function is that of receiver-transmitter—sometimes from body to mind and sometimes from mind to body."

This part of the analysis includes an account of a philo-

sophical attitude made not only possible but in some instances necessary by the new physics, which shows that a material system is a function, primarily, and can exist only because it is a function, of field properties, as a cloud is a function of the atmosphere in respect to temperature, moisture, electrostatic charges, pressure, and the like. So is a lump of iron a function of fields. So, then, is a human body, but not necessarily *only* of the two force fields so far established in physics. This new state of mind must have a name, and Ducasse proposes *hypophenomenalism*, the opposite to *epiphenomenalism*. Thus pages 75 to 106 furnish the reader with that which Myers could not command, and no other volume has so far specified. Having thus reoriented the topic to what is important in the contemporary scene, Ducasse summarizes the state of the case for the reality of sheer survival (pages 191 to 202).

He now opens up the question of life after death as a phase in an appropriately commodious conceptual system. (Of this we should bear in mind that it is not the naive linear time of the old physics, but the cyclic time of the new that is characteristic.) Hence, resuming Ducasse's argument, reincarnation must be looked into. Here our author has supplied the reader a most admirable body both of documentation and analysis. He actually provides, in each instance, the essentials of the evidence, so that the reader can judge for himself. It is a delightful and impressive performance. The cases of Katsugora, Alexandrina Samona, Shanti Devi and the "Rosemary" xenoglossy are all set forth. Then comes the question of regression through hypnosis, and an account of Edgar Cayce. Then, finally, Ducasse moves in upon the wilful disbelievers and the ingenious misleaders who had a field day (and seemed to have won it) over the case of Bridey Murphy. The reader of pages 276 to 298 will note, with a renewed sense of shame, the facts about *Life* and the *Chicago Tribune*. Dr. Ducasse never once takes up cudgels. He merely reviews and quotes the facts. The reader can do his own revolting against the sensationalism and bland incorrigibility of these two mass media, which did, on a very large scale to millions, precisely what they accuse individuals of doing to a few. They misled the public, and have apparently never explained or apologized.

This is a book which will be read for enlightenment by some of the foremost persons at work in the field of parapsychology. It will eventually reach the truly scientific men and women who are ready to re-learn and re-use in our times that which they of necessity may have misinterpreted in days when there was only space and time, not space-time; when sense-borne hypothetical science was apparently the sole authority; when there was no parapsychology but only psychical research. It is perhaps too much to hope that older and more fixed opinions among the behavioristic and physicalistic humanists will be submitted, by those who entertain them, to total re-evaluation. But Ducasse can afford to wait. He has wrought, with quiet deftness and utter reasonableness, a book which will be a classic for years to come, standing beside, and towering above, the great monument of Myers which so long furnished the only real landmark in the psychology of the paranormal.

Besides acquiring *The Belief in a Life After Death*, our readers might do well to examine *The Enigma of Survival*, by Hornell Hart, also published by Thomas, and *Mediumship and Human Survival*, by H. H. Price, Oxford University, in *The Journal of Parapsychology*, Vol. 24, No. 3, September 1960.

—*L. E. Girard*

THE READERS OF MAIN CURRENTS will, we believe, benefit substantially by reading the newest booklet in the series reporting the Arthur Stanley Eddington Memorial Lectureships: *Biology, Psychology and Belief*, by W. H. Thorpe, F. R. S., Jesus College, Cambridge. (New York: Cambridge Univ. Press, 1961, 60 pp., 90¢). The Eddington Lectureships now total fourteen, and constitute an acute running commentary on the transition in thought which Sir Arthur himself so powerfully impelled when it had only its early momentum.

Dr. Thorpe's assessment of the present state of affairs in his own field and chosen lecture topic is regardful of common sense. The eminently judicial spirit of his remarks is well represented in this passage from pages 22-23:

"I think no knowledgeable person would be prepared to hazard any guess as to what the next steps will be in this process of understanding the interaction between mind and brain and the origin of consciousness. It is, however, interesting to consider the results of recent physiological investigations on the problem of consciousness, its relation to brain mechanisms and its location—if indeed it is located in any ordinary sense of the word. We all of us at times feel that one of the most striking features of mind as compared to body is that mind is not localized in the same way. At the same time, we feel our minds to be in our heads somewhere behind and between our eyes. It is the opinion of many, particularly those who feel skeptical of the possibility of a physiological interpretation of mental function, that if the brain is the organ of liaison (the organ of mind), then the brain must be working as a whole, and consciousness must be the property of its total activity. They feel that any attempt to locate consciousness more precisely than this savors of the attempts of the savants of three centuries ago to locate the soul in the pineal body, in the juices which exuded from injured nerves, or in the fluid contained in the ventricles of the brain. Nevertheless, there is a surprising amount of modern evidence that certain parts of the brain-stem linked and interacting with the cortex or certain parts of it, are peculiarly necessary for the occurrence of conscious states. The progress of physiological investigation in this field will be awaited with intense interest by both philosophers and psychologists."